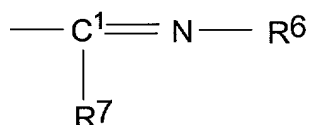


## CLAIMS

### We Claim:

1. A catalyst system comprising an activator and one or more heteroatom substituted phenoxide Group 3 to 10 transition or lanthanide metal compounds wherein the metal is bound to the oxygen of the phenoxide group and provided that:

- a) if more than one heteroatom substituted phenoxide is present it is not bridged to the other heteroatom substituted phenoxide,
- b) if the metal is a Group 4 metal then the carbon ortho to the carbon bound to the oxygen of the phenoxide is not bound to an aldehyde or an ester,
- c) the carbon ortho to the carbon bound to the oxygen of the phenoxide is not bound to the C<sup>1</sup> carbon in a group represented by the formula:



wherein R<sup>6</sup> and R<sup>7</sup> are independently hydrogen, halogen, a hydrocarbon group, a heterocyclic compound residue, an oxygen containing group, a nitrogen containing group, a boron containing group, a sulfur containing group, a phosphorus containing group, a silicon containing group, a germanium containing group, or a tin containing group, and R<sup>6</sup> and R<sup>7</sup> may be bonded to each other to form a ring,

- d) if the metal is a Group 4 metal than the ortho and metal carbons do not form a pyridine ring, and
- e) the carbon ortho to the carbon bound to the oxygen of the phenoxide is not bound to a sulfur atom directly bound to a nitrogen atom..

2. The catalyst system of claim 1 wherein the activator is selected from the group consisting of an aluminum alkyl, an alumoxane, a modified alumoxane, a borane, a borate, a non-coordinating anion or combinations thereof.

3. The catalyst system of claim 1 wherein the transition metal is a Group 4 metal.

4. The catalyst system of claim 1 wherein the transition metal is zirconium.

5. The catalyst system of claim 1 wherein the heteroatom substituted phenoxide transition metal compound is selected from the group consisting of:

bis(*N*-benzylidene-2-hydroxy-3,5-di-*t*-butylbenzylamine) zirconium(IV) dibenzyl;

bis(*N*-benzylidene-2-hydroxy-3,5-di-*t*-butylbenzylamine) zirconium(IV) dichloride;

bis(2-(2H-benzotriazol-2-yl)-4,6-di-*t*-amylphenoxide)zirconium(IV) dibenzyl;

bis(*N*-benzylidene-2-hydroxy-3,5-di-*t*-butylbenzylamine) titanium(IV) dibenzyl;

bis(2-(2H-benzotriazol-2-yl)-4,6-di-*t*-amylphenoxide)zirconium(IV) dibenzyl;

bis(2-(2H-benzotriazol-2-yl)-4,6-di-*t*-amylphenoxide)zirconium(IV) dichloride;

bis(2-(2H-benzotriazol-2-yl)-4,6-di-*t*-amylphenoxide)zirconium(IV)

di(bis(dimethylamide));

bis(2-(2H-benzotriazol-2-yl)-4,6-di-(1',1'-dimethylbenzyl)phenoxide)zirconium(IV) dibenzyl;

bis(2-(2H-benzotriazol-2-yl)-4,6-di-*t*-amylphenoxide)titanium(IV) dibenzyl;

bis(2-(2H-benzotriazol-2-yl)-4,6-di-(1',1'-dimethylbenzyl)phenoxide)titanium(IV) dibenzyl;

bis(2-(2H-benzotriazol-2-yl)-4,6-di-(1',1'-dimethylbenzyl)phenoxide)titanium(IV) dichloride;

bis(2-(2H-benzotriazol-2-yl)-4,6-di-(1',1'-dimethylbenzyl)phenoxide)hafnium(IV) dibenzyl; and

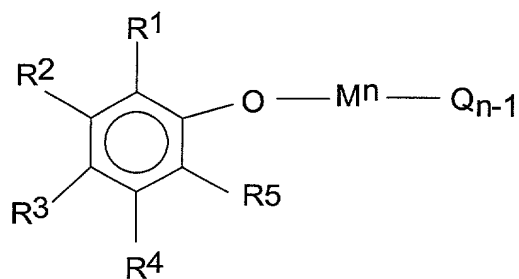
(*N*-phenyl-3,5-di-(1',1'-dimethylbenzyl)salicylimino)zirconium(IV) tribenzyl.

6. The catalyst system of claim 5 further comprising an activator comprising one or more of an aluminum alkyl, an alumoxane, a modified alumoxane, a borane, a borate or a non-coordinating anion.

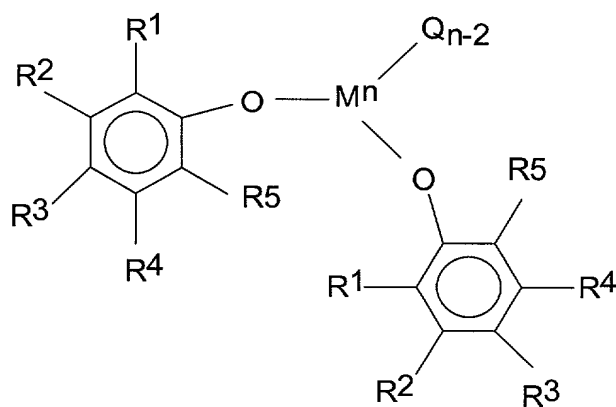
7. The catalyst system of claim 1 wherein either the transition metal compound or the activator or both are placed on a support.

8. The catalyst system of claim 1 further comprising a Ziegler-Natta catalyst.

9. The catalyst system of claim 1 further comprising a mono-or bis-cyclopentadienyl Group 4, 5 and 6 transition metal compound and an optional second activator.
10. The catalyst system of claim 1 further comprising a second activator.
11. The catalyst system of claim 1 wherein the activator is one or more of alumoxane, tris (2, 2', 2''- nonafluorobiphenyl) fluoroaluminate, triphenyl boron, triethyl boron, tri-n-butyl ammonium tetraethylborate, triaryl borane, tri (n-butyl) ammonium tetrakis (pentafluorophenyl) boron or a trisperfluorophenyl boron, or diethylaluminum chloride.
12. A catalyst system comprising the reaction product of an activator and one or more heteroatom substituted phenoxide transition metal compounds represented by the following formulae:



or



wherein:

$R^1$  to  $R^5$  may be independently hydrogen, a heteroatom containing group or a  $C_1$  to  $C_{100}$  group provided that at least one of  $R^2$  to  $R^5$  is a group containing a heteroatom, any of  $R^1$  to  $R^5$  may or may not be bound to the metal M,

O is oxygen,

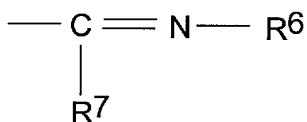
M is a Group 3 to 10 transition metal or a lanthanide metal,

n is the valence state of M,

Q is an anionic ligand or a bond to an R group containing a heteroatom which may be any of  $R^1$  to  $R^5$ , and

further provided that:

- a) if M is a Group 4 metal then  $R^5$  is not an aldehyde or an ester;
- b) the  $R^4$  and  $R^5$  groups do not form pyridine in the first formula if M is a Group 4 metal;
- c) the  $R^4$  and  $R^5$  groups do not form pyridine in at least one ring of the second formula if M is a group 4 metal; and
- d) neither  $R^1$  nor  $R^5$  may be a group represented by the formula:



wherein  $R^6$  and  $R^7$  are independently hydrogen, halogen, a hydrocarbon group, a heterocyclic compound residue, an oxygen containing group, a nitrogen containing group, a boron containing group, an sulfur containing group, a phosphorus containing group, a silicon containing group, a germanium containing group, or a tin containing group, and  $R^6$  and  $R^7$  may be bonded to each other to form a ring.

13. The catalyst system of claim 12 wherein the activator is an aluminum alkyl, an alumoxane, a modified alumoxane, a borane, a borate, a non-coordinating anion or a mixture thereof.

14. The catalyst system of claim 12 wherein Q is a bond to any of  $R^1$  to  $R^5$  and the R group that Q is bound to is a heteroatom containing group.

15. The catalyst system of claim 12 wherein the heteroatom containing group is a triazole or an oxyzole.

16. The catalyst system of claim 12 wherein the heteroatom in the heteroatom containing group is nitrogen and/or oxygen.
17. The catalyst system of claim 12 wherein the  $R^1$  group is a  $C_4$  to  $C_{20}$  alkyl group.
18. The catalyst system of claim 12 wherein  $R^1$  is a tertiary alkyl group.
19. The catalyst system of claim 12 wherein  $R^5$  is bound to the metal.
20. The catalyst system of claim 12 wherein the  $R^2$  group is a butyl, isobutyl, tertiary butyl, pentyl, hexyl, heptyl, isohexyl, octyl, isooctyl, decyl, nonyl, or dodecyl group.
21. The catalyst system of claim 12 wherein two or more R groups have formed a five or six membered ring.
22. The catalyst system of claim 12 wherein two or more R groups have formed a multi-ring system.
23. The catalyst system of claim 12 wherein M is zirconium, titanium or hafnium.
24. The catalyst system of claim 12 wherein n is 4.
25. The catalyst system of claim 12 wherein n is 3.
26. The catalyst system of claim 12 wherein Q is a halogen or an alkyl group.
27. The catalyst system of claim 12 wherein Q is an amide, carboxylate, carbamate, thiolate, hydride or alkoxide group.
28. The catalyst system of claim 12 further comprising a support.

29. The catalyst system of claim 12 wherein either the transition metal compound or the activator or the reaction product thereof are placed on a support selected from the group consisting of talc; silica, magnesium chloride, alumina, silica-alumina; polyethylene, polypropylene, polystyrene; or a mixture thereof.
30. The catalyst system of claim 12 wherein prior to being combined with the transition metal compound and/or the activator and/or the reaction product thereof the support is partially or completely dehydrated.
31. The catalyst system of claim 12 wherein the transition metal compound and the activator are combined in ratios of about 1000:1 to about 0.5:1.
32. The catalyst system of claim 12 wherein the transition metal compound and the activator are combined in ratios of about 300:1 to about 1:1.
33. The catalyst system of claim 12 wherein the activator is a borane and the transition metal compound and the borane are combined in ratios of about 1:1 to about 10:1
34. The catalyst system of claim 12 wherein the activator is an alkyl aluminum compound and the transition metal compound and the alkyl aluminum compound are combined in ratios of about 0.5:1 to about 10:1
35. The catalyst system of claim 12 wherein two or more R groups do not form a five membered ring.
36. The catalyst system of claim 13 wherein M is zirconium.